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IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

INVENTORS:

Samson Boodaghians

DOCKET NO.: 1999-0711

TITLE: LOOPBACK CAPABILITY FOR BI-DIRECTIONAL MULTI-PROTOCOL LABEL SWITCHING TRAFFIC ENGINEERED TRUNKS

SERIAL NO: 09/589,464 **GROUP ART UNIT:** 2665

FILING DATE: 06/07/00 **EXAMINER:** Toan D. Nguyen

COMMISSIONER FOR PATENTS
ALEXANDRIA, VA 22313-1450

DECLARATION UNDER 37 C.F.R 1.131

I, Samson Boodaghians, of 33 Hillside Terrace, Wayside NJ 07712, declare the following:

I am the inventor named in the application identified above;

I made the invention described and claimed in that application prior to October 1, 1999;

As evidence of that declaration, attached to this paper as Exhibit 1 are copies of pages 1, 9, and 10 of a paper bearing the date of September 23, 1999, that was written by me before September 23, 1999. That paper describes various aspects of the use of loopback packets for network management in multi-protocol label switching networks.

Declarant acknowledges that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. 1001) and may jeopardize the validity of the application or any patent issuing thereon. All statements made of the declarant's own knowledge are true and that all statements made on information and belief are believed to be true.

Date: 1/13/2004

Declarant

EXHIBIT 1

Subject: Proposed Techniques for Introducing a Loopback Capability For MPLS Explicitly Routed LSPs (ER-LSP)

Date: September 23, 1999

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DRAFT Release 0.0, September 23, 1999

Abstract

This proposal presents a number of alternative techniques for introducing a Loopback capability for MPLS Explicitly Routed LSPs (ER-LSPs). Multiprotocol-Label Switching (MPLS) is an emerging technology, which integrates IP routing with Label Switching techniques [MPLS-Arch]. MPLS promises to provide new capabilities in the area of Traffic Engineering (TE) for IP networks [MPLS-TE]. These TE capabilities will have to be combined with a set of complementary OA&M capabilities in order to effectively manage and operate MPLS-based networks. One such capability is Loopback of ER-LSPs. Although, this document focuses on implementing Loopbacks in MPLS domains, many of the ideas introduced can be used for a broader set of Network Management functionality including Loopbacks. Some preliminary discussion of Network Management Function types is presented. These Functions, the supporting protocol and the semantics are for further study.

Intellectual Property Considerations

This document contains some material on which we may seek to claim Intellectual Property.

Objective

This document is in initial draft form and is subject to change. The intention of this document is to introduce various approaches for implementing a Loopback capability in MPLS. Observe that the proposed approaches have a wider applicability in the area of MPLS OA&M. It is proposed that this document be adequately reviewed internally within AT&T and its partners to assess the feasibility of the presented approaches and reach consensus on a preferred approach. The review process should also differentiate between a set of capabilities to be presented to the MPLS standardization bodies and another set of capabilities, which can be implemented in our network for gaining competitive advantage.

6 Description of the Proposed Loopback Capability

RFC 2702 [MPLS-TE] describes six basic operations, which can be performed on an MPLS Trunk: Establish, Activate, Deactivate, Modify Attributes, Reroute, and Destroy. The reader should refer to [MPLS-TE] for a detailed description of the aforementioned operations.

A Loopback capability can be ~~added~~ introduced, as an additional functionality, into this framework. - For example, an operator can force the proposed Loopback capability after "Establishing" a BTT but before "Activating" the BTT. This action by the operator will ensure that "user" traffic will be loaded on a properly Established LSP. - This type of Loopback is called a Pre-service Loopback since the Loopback function is performed prior to loading the BTT with "user" traffic. Therefore, a Pre-service Loopback requires that, after "Establishing" the BTT, the operator activates the Loopback function, tests the BTT for continuity and then deactivates the Loopback function, prior to "Activating" the BTT.

The flow diagram depicted in Figure 6-1~~Figure 6-1~~ shows the integration of the Loopback capability within the MPLS Traffic Engineering Framework. Note that the functions indicated with bold lines are proposed in this memo. The remaining functions are already a part of the MPLS TE Framework.

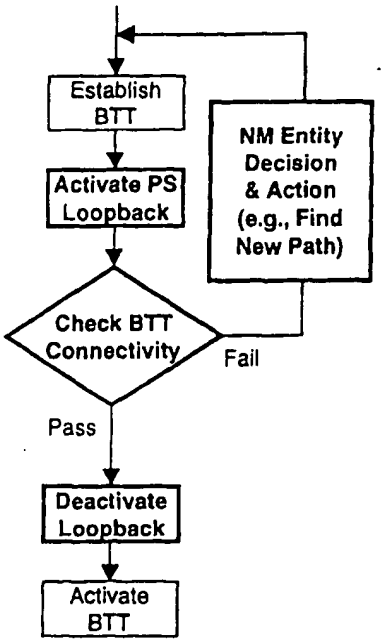
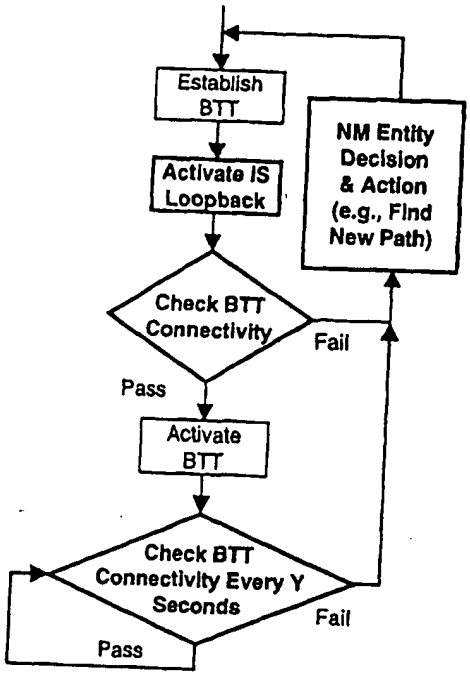


Figure 6-1 Pre Service Loopback and MPLS TE

There is also a need to monitor a BTT while it carries "user" traffic. This type of Loopback is called In-service Loopback. The In-service Loopback function has to be performed using In-band Network Management Packets (INMPs). In-service Loopback is for periodic monitoring of BTTs' continuity.

The Flow Diagram Depicted in Figure 6-2~~Figure 6-2~~ shows the integration of In-service Loopback functionality with already shown Pre-service loopback and the MPLS TE Framework.

Similarly, the functions indicated with bold lines are proposed in this memo. The remaining functions are already a part of the MPLS TE Framework.



F
igure 6-22 In-service Loopback and MPLS TE

-INMPs can also be used for other Network Management capabilities such as

- Alarm Indications in forward and backward direction. These Alarm indications can be used to propagate Alarm information between client and server signals in a Multi-layer Network.
- Single- or double-ended connectivity verification. Note that Loopback can be considered a form of double-ended connectivity verification.
- Trouble Isolation
- Performance measurement. For example probe packets can be sent to measure Round Trip Time (RTT) of a packet. Other relevant performance metrics are number of dropped packets, number of transmitted packets, etc.
- Communication of resource state information between LSRs (e.g., to ensure that the "Modify Attributes" [MPLS-TE] command has been successfully implemented on an ER-LSP).

Note that the Loopback function is particularly useful for measuring RTT since, in the case of loopback, the measurement relies on a single clock source at the ingress LSR. If RTT is measured using a single-ended connectivity technique, the clock sources at the two ends of the connection (ingress and egress LSRs) will have to be synchronized.